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Study of ferroelectric domains by scanning probe microscopy

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Application of various methods of the scanning probe microscopy for investigation of the ferroelectric domain structure, domain imaging with high spatial resolution, local switching and creation of the micro- and nanodomain patterns will be presented systematically.

The brief review and comparison of various modern methods of domain imaging in ferroelectrics including optical microscopy, scanning electron microscopy and scanning probe microscopy (SPM) will be presented. The merits and demerits of SPM methods will be considered. The first successive domain imaging using atomic force microscopy (AFM) by measuring the ferroelectric surface relief revealed by selective etching will be demonstrated. The main advantages of the most popular Piezoresponse Force Microscopy (PFM) will be discussed.

The multiple examples of successive application of the SPM tip-induced ferroelectric domain local switching for study of the domain structure with high spatial resolution and obtaining important results will be presented: (1) new mechanism of the forward domain growth in polar direction based on results of local switching on nonpolar cuts of lithium niobate crystals; (2) interaction of the isolated domains leading to intermittency and formation of the quasiperiodic and chaotic structures on polar cut of lithium niobate; (3) decay of the poled state (spontaneous backswitching) and formation of the nanodomain structures during polarization reversal in uniform field in crystals of relaxor ferroelectric strontium-barium niobate (SBN); (4) role of the external screening on spontaneous backswitching after external field switch-off on nonpolar cut of lithium niobate crystals; (5) influence of the adsorbed surface layer and increased relative humidity on the domain growth during local switching; (6) domain structure and local switching in single grains of lead-free piezoceramics; (7) influence of the charged domain walls on dielectric relaxation in lead-free piezoceramics $(K,Na)NbO_3$; (8) ferroelectric domains in microtubes of diphenylalanine peptide; (9) as-grown domain structure and features of the domain growth in non-polar cut of glycine organic crystals.